Assessing Injury to Loggerhead Sea Turtles in Alabama

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Summary

The purpose of this report is to extend the sea turtle nesting injury on Florida panhandle beaches caused by *Deepwater Horizon* oil spill response activities (Cacela and Dixon 2013) to Alabama nesting beaches where response activities also occurred. Cacela and Dixon (2013) determined that in 2010 approximately 251 fewer loggerhead nests than expected were observed on Florida panhandle beaches when compared with nest abundance on unaffected southwest Florida nesting beaches. The authors reported a significant 2010 year effect in the modeled predictions of nest abundance, which was associated with disturbance of nesting turtles by DWH beach cleanup activities. However, the analysis performed by Cacela and Dixon (2013) was restricted to nesting beaches in Florida and did not explore potentially similar effects on the continuous loggerhead sea turtle nesting beaches in Alabama. This report explores the effects of the spill and response activities on loggerhead sea turtle nesting beaches in Baldwin County, Alabama.

Introduction

Sea turtle nesting occurs along approximately 378 kilometers of Florida panhandle beaches (Escambia County through Franklin County) and on 76 kilometers of Alabama beaches (Mobile County and Baldwin County) (NMFS and USFWS 2008)Sea turtle nesting habitat in Baldwin County, Alabama, is contiguous with that of Florida (Figure 1) and includes 42 kilometers of federally designated Critical Habitat. The Baldwin County coast contains conservation lands managed by the Department of Interior (Bureau of Land Management, Bon Secour National Wildlife Refuge) and the State of Alabama (Gulf State Park).

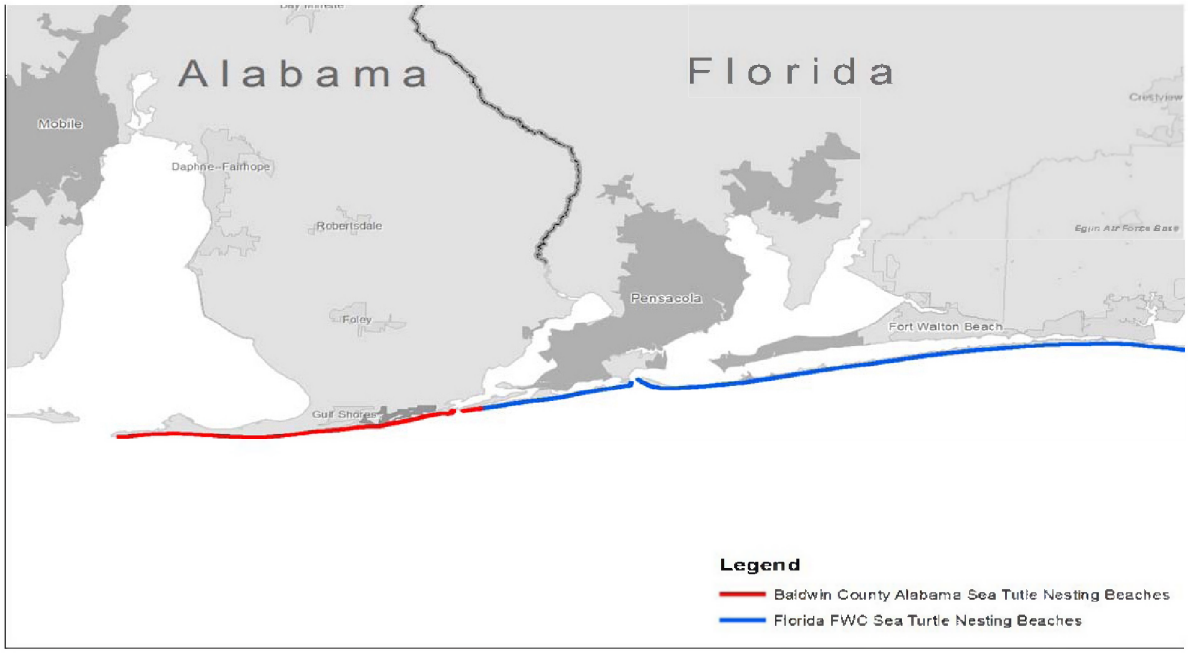

Figure 1. *The Alabama/Florida state line is a political boundary that lies within contiguous loggerhead sea turtle nesting habitat. Effects of response activities on nest densities were evaluated on Florida nesting beaches (blue) (Cacela and Dixon, 2013). Alabama loggerhead nesting beaches evaluated in this report are highlighted in red.*

Sea turtle nesting in Florida

Since 1997, Florida's Fish and Wildlife Research Institute (FWRI) has coordinated the Index Nesting Beach Survey, a detailed sea turtle nesting-trend monitoring program in Florida. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. According to Cacela and Dixon (2013), the average loggerhead nest density on the Florida Panhandle index beaches during 1997-2012 is 2.859 nests/km. Although FWRI's survey stops at the Alabama/Florida state line, sea turtle nesting habitat continues.

Sea turtle nesting in Alabama

Sea turtle nesting data are also collected in Alabama following established protocol (Isaacs 2014). This requires routes to be patrolled every morning during nesting season (i.e., May through October). Nightly stewardship at each nest throughout the season enables the collection of emergence and productivity data. In Alabama, this monitoring activity is undertaken by Bon Secour National Wildlife Refuge staff and a non-profit group, Share the Beach. Their routes (Figure 2) have been maintained for eastern Alabama beaches since 2002. Intermittently western Alabama's beaches (principally Dauphin Island, which is in Mobile County) have been monitored as well. While nesting does occur there, the data are not collected consistently enough to be used in this exercise, and the focus is on Baldwin County. Nesting data from Baldwin County, Alabama reveal nest densities within the range of nest densities on Florida panhandle index beaches (Figure 3).

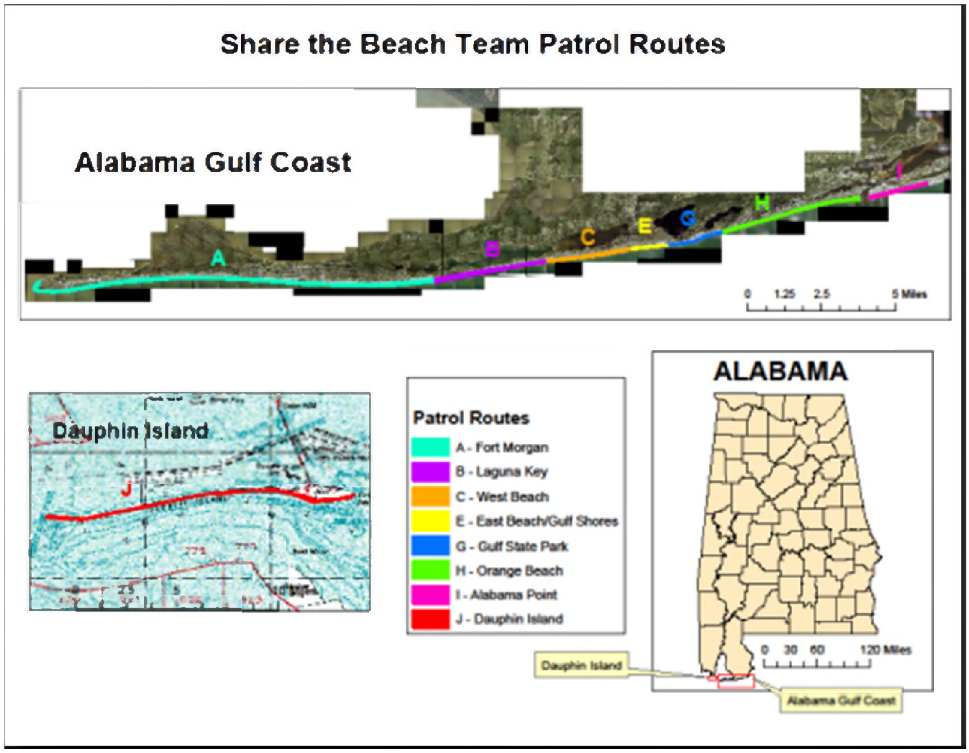

Figure 2. *The Baldwin County, Alabama Gulf Coast is surveyed daily in its entirety and can be divided up into Patrol Routes. Although Dauphin Island in Mobile County has nesting, there are some gaps in the years it has been surveyed, and it is not included in this analysis.*

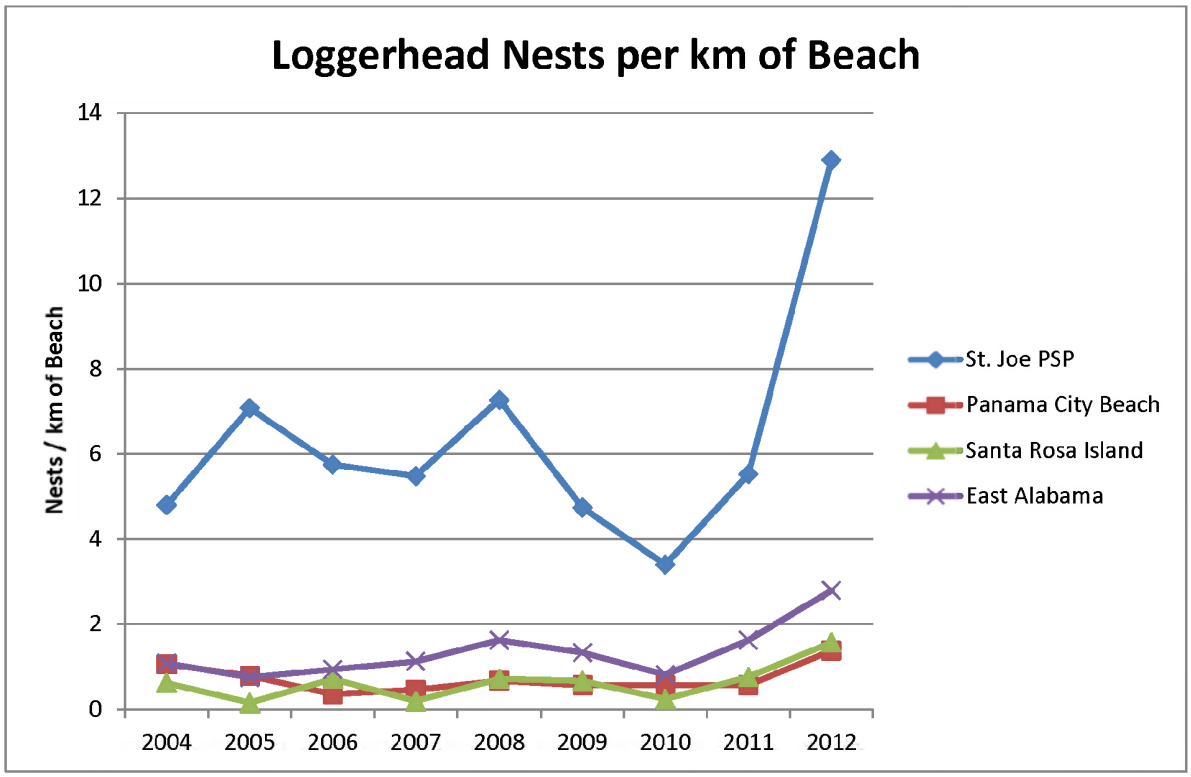

Figure 3. *Observed nesting rates of loggerhead sea turtles on beaches on the Florida panhandle and East Alabama (i.e., Baldwin County) 2004-2012.*

Sea turtle nesting and DWH in Florida

Oil first began stranding in May 2010, with shoreline cleanup beginning shortly thereafter. Oil stranding occurred in discontinuous waves over a period of months, requiring the response to employ various mechanical and manual treatments to remove oil (Michel et al. 2015). In the north central Gulf of Mexico, sea turtle nesting and hatching season extends from late April through early November (Michel et al. 2015). All nesting occurs at night, and a significant reduction in sea turtle nesting activity has been documented on beaches illuminated with artificial lights (Witherington 1992), which were commonly used by response operations. Thus, beach cleanup and associated activities that are known to disturb or deter sea turtle nesting occurred on northern Gulf of Mexico shorelines during g the 2010 sea turtle nesting season (Michel et al. 2015).

In 2010, there was a decline in nest density compared to previous and subsequent years on beaches on the Florida panhandle (Figure 3; Table 1). Although annual nest densities fluctuate, Cacela and Dixon (2013) determined the 2010 nest density was lower than expected as a result of beach clean-up activities related to the DWH oil spill having deterred adult female turtles from nesting.

Following the purpose of the FWRI Index Beach program, Cacela and Dixon (2013) applied nesting data gathered on those beaches to all beaches in their study area (i.e., the Florida panhandle). The density of sea turtle nests that were "lost" (i.e., never occurred on those beaches) on the Index Beaches was estimated to be 0.663 nests/km of shoreline, or a reduction of approximately 43.7% (Cacela and Dixon 2013). By multiplying this nest density reduction by the length of nesting beaches in the Florida

panhandle (377.8 km), Cacela and Dixon (2013) estimated unrealized nests on Florida panhandle beaches as:

0.663 nest/km x 377.8 km = 251 lost nests in Florida

Sea turtle nesting and DWH in Alabama

In order to estimate a similar degree of potential injury to the Baldwin County coast, time series nesting data from Alabama can be coupled with the Cacela and Dixon (2013) assessment to extrapolate injury in Alabama. Although oiling was observed on Florida panhandle beaches, Baldwin County, Alabama, and its Gulf beaches were classified as heavier oiling (Figure 4), with the exception of the beaches on either side of the entrance to Perdido Bay, which were mostly classified as lighter oiling (Michel et al. 2015). Baldwin County beaches also had many areas with submerged oil mats in the nearshore subtidal zone (Michel et al. 2015). Oiling intensity and corresponding response activities were higher in Baldwin County, Alabama, than the overall area in Florida addressed by the Cacela and Dixon (2013) analysis (Michel et al. 2015). Therefore, injury to nesting sea turtles could be expected to be proportionally equal if not greater on these nesting beaches.

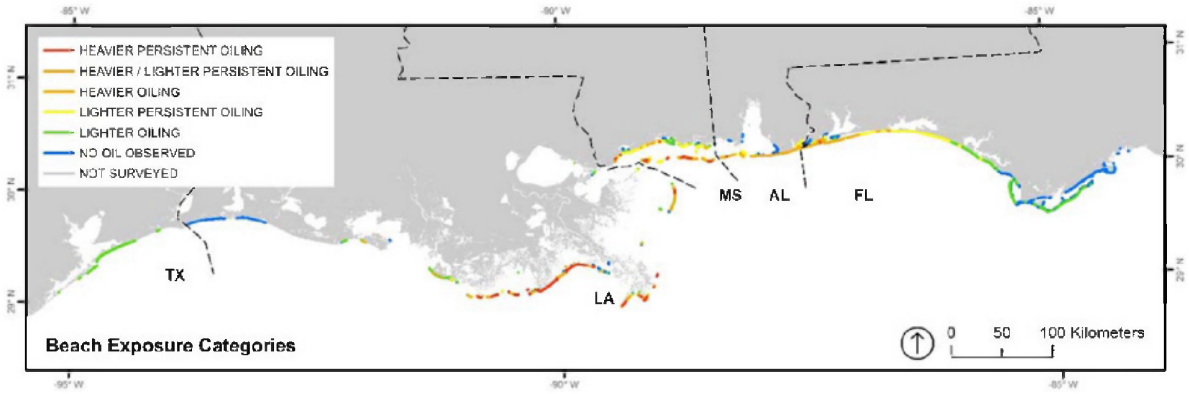

Figure 4. *Observed sand beach oiling rates (Michel et al. 2015).*

As on Florida panhandle beaches, nest density observed in Baldwin County during 2010 was considerably lower than other years (Figure 3; Table 1); second lowest only to 2005, an uncommonly destructive year in which the Alabama coast took direct hits from Hurricanes Dennis in July and Katrina in August. In 2010, the mean nest density on the Florida panhandle Index Beaches declined nearly 44% from expected; in Alabama there was also a reduction in observed nest density in 2010 relative to previous and subsequent years (Table 1). Although observed nesting rates fluctuate annually, the estimated decline in 2010 on Florida panhandle nesting beaches and contiguous Alabama nesting beaches demonstrates the potential for a significant relationship between the loggerhead nest density and DWH response activities along this coastline. Further, as mentioned above, nest densities in Baldwin County are consistently within the range of nest densities of Florida panhandle beaches. Based on these comparable nest density trends along a contiguous stretch of loggerhead nesting habitat, level of oiling and response activities on the Alabama nesting beaches, it is reasonable to extend the examination of a 2010 year effect from Florida panhandle beaches (Cacela and Dixon 2013) to estimate potential reduction in nests on contiguous Alabama beaches.

Therefore, we applied the proportional reduction in observed nest density relative to expected nest density for Florida panhandle beaches (i.e., 43.7% reduction, or 56.3% of expected; Cacela and Dixon 2013) to the observed nest density in 2010 in Baldwin County, Alabama (0.813 nests/km) to calculate the expected nest density. This calculation (0.813/56.3%) yielded an expected nest density estimate of approximately 1.444 nests/km Next, we subtracted the observed nest density (0.813 nests/km) from the expected nest density (1.444 nest/km) to calculate the reduction in nest density. This calculation yielded a reduction in nest density of approximately 0.631 nest/km.

Finally, we estimated the number of nests "lost" due to potential deterrence of nesting females coming ashore to nest by multiplying the nest density reduction (0.631 nest/km) by the 48.0 km of Alabama nesting beach habitat. This calculation yielded an estimate of approximately 30 "lost" nests. This does not take into account the nests that may have been lost in the western portion of Alabama's coast (i.e., Mobile County).

Note that since these values were derived using a different statistical methodology than that used by Cacela and Dixon (2013), they do not represent Alabama-specific estimates of expected nest density, nor of potential nest reduction, but rather estimates based on the assumption that nest density reduction on Alabama beaches were proportionally identical to those quantified on Florida panhandle beaches.

Hatchling emergence success rates (defined here as hatchlings making it to the water) tend to vary greatly by year and location (NMFS and USFWS 2008). For this analysis, we used data collected in Alabama in 2010 (Isaacs 2014) enabling a robust comparison of what the hatchling success rate would have been for those lost nests in 2010. According to Isaacs (2014), there were 20 nests that contained 2,261 eggs, or an average of 113 eggs/nest. The observed hatchling emergence success rate for those nests was 57.2%, which yields an average of 65 hatchlings surviving per nest. The number of hatchlings lost in 2010 in Alabama, therefore is estimated as:

65 hatchlings/nest x 30 nests = 1,950 hatchlings

The estimated number of hatchlings lost in Alabama in 2010 as a result of response activities related to DWH that deterred sea turtle nesting on beaches is 1,950.

Table 1. *Comparison of loggerhead nests per kilometer of beach in four locations of northern Gulf of Mexico. Data from the Florida panhandle are sourced from Cacela and Dixon (2013); Alabama data are from Isaacs (2014). "Alabama East" is synonymous with Baldwin County.*

	Florida Panhandle nests/km			Alabama nests/km
Year	St. Joe PSP	Panama City Beach	Santa Rosa Island	Alabama East
2004	4.800	1.058	0.619	1.083
2005	7.081	0.789	0.155	0.750
2006	5.752	0.354	0.715	0.938
2007	5.482	0.460	0.194	1.125
2008	7.272	0.673	0.715	1.625
2009	4.742	0.566	0.667	1.333
2010	3.400	0.566	0.242	0.813
2011	5.527	0.569	0.762	1.625
2012	12.896	1.381	1.572	2.792

References

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